

Is part-time employment beneficial for firm productivity?

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IS PART-TIME EMPLOYMENT BENEFICIAL FOR FIRM PRODUCTIVITY?

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With this article, the authors are the first to analyze and explain the relationship between part-time employment and firm productivity. Using a unique data set on the Dutch pharmacy sector that includes the working hours of all employees and a “hard” physical measure of firm productivity, the authors estimate a production function including heterogeneous employment shares based on working hours. The authors find that firms with a large part-time employment share are more productive than firms with a large share of full-time workers: a 10% increase in the part-time share is associated with 4.8% higher productivity. Additional data on the timing of labor demand show that this can be explained by a different allocation of part-timers compared with full-timers. This enables firms with large part-time employment shares to allocate their labor force more efficiently across working days.

In many countries, the fraction of the workforce employed on a part-time basis is large, particularly among females. In the European Union, almost one-third of prime-aged women work part-time (Eurostat 2010), while in the United States about 27% of the workforce in non-agricultural sectors of industry has a part-time job (Bureau of Labor Statistics 2011). Both in Europe and the United States, these percentages are even larger in the service sector, which is the largest sector in terms of value added and employment. In Europe, 70% of the working population is employed in a service-sector job (OECD Stat Extracts 2010) compared with 80% of the working population in the United States (Bureau of Labor Statistics 2011). Moreover, analysts expect that the service sector will add even more jobs in the future

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(Woods 2009). Given this information, knowing how part-time employment is related to firm productivity in the service sector is highly relevant, not only for employers but also for policymakers.

From a theoretical point of view, whether part-time employment is positively or negatively related to firm productivity is not clear. On the one hand, human capital theory predicts part-time workers to be less productive than full-time workers because they face a lower return on their human capital investments. Research on the part-time pay penalty suggests that this is indeed the case (e.g., Aaronson and French 2004; Baffoe-Bonnie 2004). On the other hand, some studies on part-time labor demand suggest that part-time employment might be beneficial at the firm level when, for example, operating hours exceed the full-time working week or when firms face fluctuations in customer demand during the day or working week (e.g., Owen 1978; Delsen 2006). The potential benefits of part-time employment will particularly be relevant for service sector firms.

In this article, we analyze and explain the relationship between part-time employment and firm productivity in service sector firms. For this purpose, we estimate a production function including heterogeneous employment shares (e.g., Hellerstein, Neumark, and Troske 1999; Ilmakunnas and Maliranta 2005; Dearden, Reed, and Van Reenen 2006) based on employees' working hours.

The empirical identification of the correlation between part-time employment and firm productivity requires at least three specific features of the data: 1) a homogeneous sector in terms of capital use and a homogeneous workforce in terms of the level of education, 2) information on the work hours of all employees in the firm, and 3) a "hard" physical or monetary measure of productivity.¹ We use a unique matched employer–employee data set on Dutch pharmacies that fulfills all three requirements and that can be considered characteristic of service sector firms whose hours of business exceed the full-time workweek. Our analyses focus on the core workers in the sector (Osterman 1994, 2000), that is, pharmacy assistants, who account for 70% of the sector's total employment, measured in full-time equivalents (FTEs). Nearly all pharmacy assistants are females and share the same educational background (both in level and in field) required by law to be employed in their profession. Administrative data on the working hours of all employees in the sector enable us to construct firms' part-time and full-time labor shares based on working hours. Moreover, the number of prescription lines delivered to customers serves as a "hard" firm-level productivity measure.

Other studies dealing with the connection between part-time employment and firm productivity have merely included a dummy variable to indicate the existence or importance of part-time employment (Arvanitis

¹Value added and other financial measures of productivity are highly volatile. Physical measures of productivity do not have this disadvantage because they capture productivity in a more straightforward manner (e.g., Ichniowski and Shaw 2003).

2005) or were restricted to subjective productivity measures (Pérotin and Robinson 2000). Our data set enables us to more precisely estimate the relationship between part-time employment and firm productivity. Additional data on the timing of labor demand enable us to explain this relation by thoroughly examining possible allocation efficiencies provided by the use of part-time employment.

Related Literature

Although production function studies have included heterogeneous employment shares based on skill level, training participation, age, and/or gender (e.g., Ilmakunnas and Maliranta 2005; Zwick 2006; Iranzo, Schivardi, and Tosetti 2008), they implicitly assume that part-time and full-time workers are equally productive in the hours they work. This premise is in sharp contrast to studies dealing with the effect of part-time employment on hourly wages. Most studies found that part-time workers earn less than full-time workers in the hours they work (e.g., Ermisch and Wright 1993; Aaronson and French 2004; Baffoe-Bonnie 2004). The assumption that wages reflect productivity suggests that part-timers are less productive than full-timers during the hours they work. Exceptions are Manning and Petrongolo (2008) and Hirsch (2005), who found that including information on skill requirements or occupations almost fully closes the gap between the hourly wages of part-time and full-time workers.

Apart from these individual productivity effects, part-time employment can also affect firm productivity at the establishment level. Literature on part-time labor demand suggests that large shares of part-time employment might lower firm productivity because of the relatively high quasi-fixed labor costs of part-time compared with full-time workers (e.g., Oi 1962; Owen 1978; Montgomery 1988). At the same time, this stream of literature provides explanations for large shares of part-time employment to increase allocation efficiencies. Several industry-specific characteristics lead to a relatively high demand for part-time employment. John Owen (1978) argued that firms employ part-time labor to avoid hiring overlapping shifts of full-time workers in industries for which operating hours exceed the full-time 40-hour working week. Furthermore, Owen hypothesized that employers will use part-timers when fluctuations occur in customer demand. His results indeed show that the relative demand for part-time labor is higher in industries with an uneven distribution of temporal service demands than in other industries. Vincent Mabert and Michael Showalter (1990) also argued that the introduction of part-time employment implies efficiency gains in service sector firms that face fluctuations in customer demand because of the accompanying reduction in the number of hours during which workers are inactive due to lack of demand. These scenarios suggest allocation efficiency by using part-time employment.

Research on the effect of part-time work on firm productivity is scarce, however, and is limited to the inclusion of a part-time dummy for the presence

or importance of part-time employment in firms.² Spyros Arvanitis (2005) constructed a dummy variable to indicate whether part-time work is important for the firm. He found a negative relation between the importance of part-time work and sales per FTE. Whereas Virginie Pérotin and Andrew Robinson (2000) included a variable measuring the fraction of part-time employment in their analyses, their data set was restricted to subjective productivity measures. They did not find a significant relationship between the proportion of part-time employment and managers' self-assessed labor productivity.³

Empirical Approach

Our approach is inspired by three papers that modeled the productivity effects of different employment shares (Hellerstein et al. 1999; Ilmakunnas and Maliranta 2005; Dearden et al. 2006).⁴ The strategy assumes that different types of employees are perfect substitutes but can have different marginal productivities. The sector under scrutiny, the Dutch pharmacy sector (see Data and Descriptive Statistics), employs a homogeneous core workforce with respect to education and gender, which allows us to divide the workforce into three employment shares: part-time (PT) and full-time (FT) core workers and other employees (OE; e.g., administrative and cleaning staff). With the latter as our reference group, and its productivity normalized to unity, the relative productivity of the part-time employment share equals γ_{pt} and the relative productivity of the full-time employment share equals γ_{ft} . If the γ 's are larger than unity, the relevant employment share is more productive than the reference group of other employees. The quality-adjusted labor input is therefore:

$$(1) \quad L^* = L \left[1 + (\gamma_{pt} - 1) \frac{PT}{L} + (\gamma_{ft} - 1) \frac{FT}{L} \right].$$

Under the assumption that the values for $(\gamma_{pt} - 1)PT/L$ and $(\gamma_{ft} - 1)FT/L$ are "small," we can simplify Equation 1 by the following approximation:⁵

²One exception is a French study by Roux (2007) that examined the effect of part-time labor shares relative to full-time labor shares on firms' value added. This study does not focus on a homogeneous workforce, however, which complicates identification of the part-time employment effect.

³Whereas our study is the first to examine possible productivity differences between part-time and full-time working hours, literature has been published on the productivity differences between standard and overtime hours. Most of these studies used data at the industry level (e.g., Feldstein 1967; Craine 1973). As criticized by Leslie and Wise (1980), interpreting these results is difficult since the coefficient for the average working week can reflect other differences between industries.

⁴Dearden et al. (2006) allowed for productivity differentials by training participation, education, occupation, age, tenure, and gender. Ilmakunnas and Maliranta (2005) included employment shares based on age, level and field of education, and gender. Hellerstein et al. (1999) distinguished employment shares by gender, race, marital status, age, education, and occupation.

⁵Following Dearden et al. (2006) and Ilmakunnas and Maliranta (2005), we make this assumption to simplify the estimation, which makes ordinary least squares (OLS) estimation possible. However, the assumption can be relaxed without affecting our main findings. Following Hellerstein et al. (1999), we also

$$(2) \quad \ln\left(1 + (\gamma_{pt} - 1)\frac{PT}{L} + (\gamma_{ft} - 1)\frac{FT}{L}\right) \approx (\gamma_{pt} - 1)\frac{PT}{L} + (\gamma_{ft} - 1)\frac{FT}{L}.$$

The part-time and full-time employment shares are thereby directly included in a log-form production function. Using the quality-adjusted labor input (L^*), we write the Cobb-Douglas production function as follows:⁶

$$(3) \quad Y = AK^\alpha L^{*\beta}$$

where output (Y) is a function of capital K and quality-adjusted labor L^* . Taking the logs of terms and using the approximation in Equation 2, we have

$$(4) \quad \ln(Y) = \ln(A) + \alpha \ln(K) + \beta \ln(L) + \beta(\gamma_{pt} - 1)\frac{PT}{L} + \beta(\gamma_{ft} - 1)\frac{FT}{L}.$$

We follow Ilmakunnas and Maliranta (2005) in allowing for deviations from constant returns to scale. When FTEs are used instead of the number of workers, L , the production function becomes

$$(5) \quad \ln(Y) = \ln(A) + \alpha' \ln(K) + (\alpha' - \beta' - 1)\ln(FTE) \\ + \beta'(\gamma'_{pt} - 1)\frac{PT_{FTE}}{FTE} + \beta'(\gamma'_{ft} - 1)\frac{FT_{FTE}}{FTE}.$$

where PT_{FTE} and FT_{FTE} denote the number of part-time and full-time FTEs per firm, respectively.

Contrary to the three studies mentioned above, our focus on one particular sector allows us to assume that the capital/labor ratio is homogeneous across firms.⁷ Therefore, the following production function is estimated:

$$(6) \quad \ln(Y) = \theta + \delta \ln(FTE_i) + \phi_{pt} pt_i + \phi_{ft} ft_i + \varepsilon_i$$

where pt_i and ft_i denote firms' part-time and full-time employment shares as defined as PT_{FTE}/FTE and FT_{FTE}/FTE , respectively. Moreover, θ is a constant term and includes $\ln(A)$ and α' . δ equals $(\alpha' - \beta' - 1)$ and ϕ_{pt} and ϕ_{ft} denote $\beta'(\gamma'_{pt} - 1)$ and $\beta'(\gamma'_{ft} - 1)$, respectively. If ϕ_{pt} and ϕ_{ft} are larger than zero, results imply that firm productivity is larger when firms have large shares of (part-time or full-time) core employees instead of large shares of other employees. If ϕ_{pt} is significantly larger than ϕ_{ft} , firms with a large share of

estimate a nonlinear least squares model. The results are similar, with the productivity differential between firms' shares of part-time and full-time employment being statistically significant.

⁶Since we assume capital use to be homogeneous across firms and workers, we have only one production input, quality-adjusted labor, and cannot estimate a translog production function as Hellerstein et al. (1999) did.

⁷Van Ours and Stoeldraijer (2011) also ignored capital in their Cobb-Douglas production function with quality-adjusted labor (based on age). In a sensitivity analysis they used depreciation on fixed assets as a proxy for capital and concluded that including or ignoring capital information does not affect the parameter estimates of production functions. This approach is in line with studies that found no or only small productivity effects of capital (e.g., Hellerstein et al. 1999; Dostie 2011).

part-time workers will be, on average, more productive than firms with a large share of full-time workers. We do not interpret a significant difference between ϕ_{pt} and ϕ_{ft} as a marginal productivity difference between part-time and full-time workers because the coefficients could reflect allocation efficiencies related to part-time employment. Instead, we interpret the difference $\phi_{pt} - \phi_{ft}$ as an establishment-wide productivity shift due to the use of more part-time work within the firm.⁸ Such an establishment-wide productivity shift could reflect allocation efficiencies related to part-time work. With additional data on the scheduling of pharmacy assistants we analyze this possibility. In alternative specifications, the model also controls for worker, pharmacist, firm, and market characteristics.⁹

Data and Descriptive Statistics

We use a unique matched employer–employee data set of Dutch pharmacies that fulfills all requirements to identify the relation between part-time employment and firm productivity.¹⁰ This data set includes two sources of information for the year 2007: 1) employee administrative data and 2) an employer survey.¹¹ The data sets are merged on the basis of a unique firm identifier. In January 2008, there were 1,893 registered pharmacies. For 1,829 of those pharmacies, an e-mail address was available, which we used to invite the pharmacist in charge of the firm to participate in a web-based survey. Invitations were sent in January 2008, with follow-up reminders in February and March 2008. Our final sample consists of 235 firms with valid information on key variables used in this study. Analyses related to the non-response show that our sample is selective with respect to a pharmacy's geographical location and the average tenure of employees, but not with respect to the firm's other characteristics.¹² Therefore, we include regional dummies and the average tenure of core workers in all analyses.

⁸The distinction in interpreting productivity functions either in terms of marginal productivity effects of two groups of workers, or in terms of an establishment-wide productivity shift due to employing one type of workers, is also common in the literature on union effects on productivity (e.g., Brown and Medoff 1978).

⁹We perform several robustness checks to see how sensitive our results are to the model specifications. Moreover, we perform panel analyses with a small panel of 95 firms.

¹⁰Dutch pharmacies are independent, for-profit firms that serve an average of about 8,000 clients (Dutch Foundation for Pharmaceutical Statistics [SFK] 2008).

¹¹This data set is provided by the pharmacy sector's pension fund (PMA) and contains information on all employed workers within the sector. The data are from January 1, 2008, and refer to the year 2007. Also the survey questions pertain to the year 2007.

¹²For 159 firms, the e-mail invitation was bounced back because the address was erroneous or the pharmacy owner had changed. In addition, 58 firms for which we had an e-mail address could not be matched to the administrative data on employees. So our non-response analyses could be performed on 1,612 firms. Our sample is representative with respect to key variables in our analysis, namely, the number of prescription lines delivered in 2007 and the distribution of hours within firms. Our selectivity analysis is available in Web Appendix A, which can be found at <https://sites.google.com/site/annemariekuennnelen/web-appendix-ilr>.

Dependent Variable

Our dependent variable is firm productivity, which is measured in the employer survey by the number of prescription lines delivered to customers by a given firm in 2007.¹³ Every prescription line refers to a particular medicine that has been prescribed by a family doctor. In the Netherlands, this is the only possible way to obtain registered medicines. The number of prescription lines and firm sales are closely related due to the fixed amount of 6.10 Euros that pharmacies receive for each prescription line, and pharmacies have only a small market share in the sale of non-registered medicines.¹⁴ The physical character of this productivity measure ensures a relatively “hard” measure of firm productivity (Ichniowski et al. 1996). Table 1 reports sample statistics of our employer–employee sample. On average, firms delivered 78,291 ($\exp(11.21)$) prescription lines in 2007. This number is very similar to the average number of prescription lines of 78,000 over the 1,890 pharmacies in 2007 as published by the Dutch Foundation for Pharmaceutical Statistics (SFK) (2008).¹⁵

Explanatory Variables

Our main variables of interest are firms’ heterogeneous employment shares in terms of FTEs. Therefore, we need to know the number of work hours of all the workers within all the firms. Information on contractual work hours for pharmacy assistants and other support staff is available in the administrative data set. Information about the work hours of pharmacists is available from the employer survey. With these data, we can distinguish between firms’ shares of part-time core employees, full-time core employees, and other employees. We focus on the core workers, that is, pharmacy assistants,¹⁶ because of their homogeneity with respect to several characteristics. Pharmacy assistants all have the same educational background (in terms of both level and field) required by law. Moreover, the population of pharmacy assistants is homogeneous with respect to gender, 99% being female. We compute firms’ part-time and full-time (core) employment shares as follows: $pt_i = PT_{FTE}/FTE$ and $ft_i = FT_{FTE}/FTE$.¹⁷

¹³De Grip and Sieben (2005) used the same measure of productivity in their analyses on firm productivity in the pharmacy sector.

¹⁴In the Netherlands, most non-registered medicines are bought in firms other than pharmacies: commercial drugstores and supermarkets have a market share of 85% for non-registered medicines. Data accessed from IMS Health, http://www.hbd.nl/pages/15/Bestedingen-en-marktaandeelen/Drogisterijen/Zelfzorg-en-gezondheidsproducten.html?subonderwerp_id=282 (June 2010).

¹⁵SFK is an independent foundation that publishes key indicators for the pharmacy sector in the Netherlands.

¹⁶Osterman (1994, 2000) defined these core workers as the largest group of nonsupervisory, non-managerial workers in a firm who are directly involved in making the product or providing the service. From a survey among pharmacy assistants, we know that pharmacy assistants spend a marginal fraction of their working time (10%) on tasks other than direct servicing of customers, e.g., administrative tasks.

¹⁷Firms’ share of other employees is constructed the same way: $oe_i = OE_{FTE}/FTE$.

Table 1. Sample Statistics of Dependent and Explanatory Variables

<i>Variable</i>	<i>Mean</i>	<i>Standard deviation</i>	<i>Minimum</i>	<i>Maximum</i>
Dependent variable				
Number of prescription lines (log)	11.21	0.38	8.89	11.98
Explanatory variables				
Firms' part-time employment share (in FTEs)*	0.19	0.11	0	0.51
Firms' full-time employment share (in FTEs)*	0.50	0.15	0.08	1.00
Control variables				
Firms' total number of FTEs (log)	2.22	0.40	0.73	3.09
Assistants' average age in years	38.06	4.35	22.50	50.00
Assistants' average firm tenure in years	8.32	3.10	0.81	17.93
Pharmacist tenure in years	15.86	8.49	0	39.00
Independent pharmacy (yes/no)	0.42	0.49	0	1
Number of hours open per week	49.88	12.28	6.00	168.00
Firm size (0–5 FTE)	0.07	0.26	0	1
Firm size (6–10 FTE)	0.51	0.51	0	1
Firm size (11–15 FTE)	0.30	0.46	0	1
Firm size (16–25 FTE)	0.12	0.32	0	1
Excess labor (yes/no)	0.13	0.33	0	1
Absentee ratio	0.04	0.04	0	0.30
Newly founded firms	0.04	0.19	0	1
Percentage of elderly within postal code area	0.22	0.07	0	0.60
Number of competitors within a radius of 5 km	9.65	12.26	0	77.00

Notes: * concerns pharmacy assistants only. Sample statistics are based on the final sample (235 pharmacies).

Given that the standard full-time workweek in the pharmacy sector is 36 hours, we define part-time workers as pharmacy assistants with fewer than 24 contractual working hours, that is, fewer than three working days. This definition differs from the definitions of part-time work usually used in the part-time employment literature. Although no standard is generally agreed upon, definitions ranging from 30 to 35 hours a week are most common (e.g., Connolly and Gregory 2008; Manning and Petrongolo 2008). Our definition, however, is well suited within our context. The Netherlands is known for its large share of part-time employment. Moreover, the pharmacy sector employs almost exclusively female pharmacy assistants with less than full-time work hours. Within the Netherlands as a whole, around 50% of all working women work fewer than 24 hours. In the pharmacy sector, 42% work fewer than 24 hours per week.¹⁸ Whereas working fewer than two days (16 hours) is uncommon in the sector (6%), working part-time is not. The largest group of core workers (36%) is employed between 16 and 24 hours per week. Workweeks of 24 to 32 hours (26%) and 32 to 36 hours (32%) per week are also quite common in the pharmacy sector. A total of 20% of all pharmacy assistants work exactly 36 hours per week. Nevertheless, we check

¹⁸The difference in the percentage of part-timers working is due to a larger percentage of Dutch women (compared with Dutch pharmacy assistants) working in jobs with fewer than 16 hours a week (own computations based on data from Dutch Labor Supply Panel 2006).

the robustness of our findings by using other definitions of part-time employment and by dividing the core workers into more employment shares.

Table 1 reports the average sizes of firms' employment shares and shows that firms' part-time employment share is, on average, equal to 0.19, and their full-time employment share is, on average, equal to 0.50.¹⁹ This large difference between firms' part-time and full-time employment shares is because both shares are measured in FTEs. Together, core workers account for almost 70% of a given firms' total employment. Apart from these core workers, pharmacies employ pharmacists and other support staff. Most important among the latter are assistants' support staff and student pharmacy assistants. Assistants' support staff help pharmacy assistants in activities related to the production process. Student pharmacy assistants are involved in a dual training track combining work and classroom education.²⁰

Control Variables

Since firm productivity can also be influenced by worker, pharmacist, firm, and market characteristics, we control for such confounders. We include the total number of firms' employees, in FTEs, to take into account deviations from constant returns to scale. On average, firms' total number of FTEs equals 9.9.²¹ Regarding worker characteristics, we include the average age and tenure of the core workers, which is available from the administrative data covering all employees. Table 1 shows that assistants are on average 38 years old and have a firm tenure of slightly more than 8 years.²² We include the pharmacist's tenure to control for productivity differences due to employers. On average, pharmacists have a tenure of almost 16 years. The firm characteristics we include in our analyses are pharmacy type (independent or part of a larger group), a dummy variable for firms that settled in the last two years (newly founded firm), number of opening hours, size dummies based on firms' FTEs, and variables related to possible inefficiencies in the firm's allocation of labor: a dummy variable equal to 1 when employers report excess labor, and 0 otherwise, and a variable measuring absenteeism due to sickness leave from the fraction of workers calling in sick during the last calendar year. Moreover, two standardized factors related to management styles are included. One factor can be characterized as the degree of availability of several human resource schemes (e.g., life-course savings scheme, child care schemes), and the other as the extent to which human resource development practices are used in the firm (e.g., performance interviews, personal development plan).

¹⁹As the analysis in Appendix A shows, the vast majority of firm characteristics are unrelated to firms' share of part-time employment.

²⁰Because of the involvement of all employment types in the primary production process, all employees in the sector are substitutes.

²¹Table 1 reports the logarithmic form because we use the log form in the analyses as well.

²²Since the majority of assistants are female and career breaks are common, we include both age and tenure in the analyses. Since the correlation between age and tenure is 35%, including both variables will not cause any problems in the estimations.

These variables are constructed from the employer survey. Table 1 shows that 42% of pharmacies are characterized as independent firms. The rest cooperate with other pharmacies, either in terms of chains or franchises or as part of legalized partnerships.²³ A total of 4% of the firms are newly founded. On average, pharmacies are open for around 50 hours a week, while the full-time working week for pharmacy assistants equals 36 hours. Firms with at most 5 FTEs are not so common (7%). About half of the firms employ between 6 and 10 FTEs. A total of 13% of the firms report excess labor. The average annual absentee rate is 4%.

Finally, we account for two market characteristics that can affect productivity across firms and regions: the demand for medicines in the neighborhood where the pharmacy is located and the degree of local competition. We proxy the demand for medicines by the percentage of elderly (60+ years old) living within the pharmacy's postal code (four digits) area. Table 1 shows that, on average, the percentage of elderly within a postal code equals 22%.²⁴ The degree of competition is measured by the number of competitors within a radius of 5 kilometers. This is calculated as the distances between all the pharmacies in the sample and all the other pharmacies located in the same region on the basis of postal codes.²⁵ Table 1 shows that the number of competitors differs considerably across firms. Although, on average, firms have around 10 competitors, some have no competitors. The pharmacy facing the most competition has 77 competitors within a radius of 5 kilometers.

Results

Part-Time Employment and Firm Productivity

Table 2 shows the estimation results of several specifications of our production function. Column (1) takes into account only the scale effect and the two employment shares. The difference between the coefficients of firms' shares of part-time and full-time employees ($\phi_{pt} - \phi_{ft}$) equals 0.562 and is significant at the 1% level. The 0.56 log point difference in coefficients between firms' part-time and full-time employment shares implies that a 10% increase in the part-time share (which is roughly one standard deviation) is associated with 5.6% higher productivity.²⁶

Column (2) reports the regression results when including worker, pharmacist, and firm characteristics. The main results remain the same; however,

²³Nevertheless, pharmacies in the Netherlands are not located in supermarkets or drugstores but are stand-alone establishments (SFK 2008).

²⁴These data are from the online statistical database of Statistics Netherlands (CBS Statline).

²⁵We use a standard Dutch regional classification (COROP). The Netherlands counts 40 COROP regions, and every COROP region has a central point (city) with a surrounding service area.

²⁶This productivity differential is close to the raw productivity difference between the quartiles of the part-time employment share (4.7%). See Figure W1 in Web Appendix B at <https://sites.google.com/site/annemariekuennnen/web-appendix-ilrr>.

Table 2. Estimation Results of Production Functions with Heterogeneous Labor Shares Based on Work Hours

<i>Dependent variable: Productivity (logs)</i>	(1)	(2)	(3)
Total amount of labor in FTEs (logs)	0.738*** (0.044)	0.578*** (0.110)	0.586*** (0.110)
<i>Firms' employment shares (other employees are reference group)</i>			
Firms' part-time employment share in FTEs	0.947*** (0.182)	0.812*** (0.186)	0.875*** (0.194)
Firms' full-time employment share in FTEs	0.385*** (0.143)	0.415*** (0.142)	0.400*** (0.143)
Constant	9.175*** (0.157)	9.596*** (0.266)	9.553*** (0.276)
Worker, pharmacist and firm characteristics	No	Yes	Yes
Market characteristics	No	No	Yes
Adjusted R-squared	0.556	0.591	0.589
N	235	235	235
Model	OLS	OLS	OLS
Wald Tests: PT share = FT share	13.05	5.81	7.06
Prob > F =	0.0004	0.0167	0.0085

Notes: Standard errors are in parentheses. Specification (1) includes region dummies. Specification (2) additionally includes assistants' average age and tenure, pharmacist tenure, the firm's number of open hours per week, two standardized factors related to management style, firm size dummies, the firm's absentee ratio, and dummy variables to indicate independent firms, excess labor, and newly founded firms. Specification (3), moreover, includes market characteristics: the percentage of elderly living in the firm's postal code area and the number of competitors within a radius of 5 km.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

the productivity differential is slightly smaller when including control variables. The finding that firms with a large share of part-time employees are more productive than firms with a large share of full-time employees still holds at the 2% level. We do not report the control variables, since most of them are insignificant. One exception is the dummy variable for newly founded firms. We find that newly founded firms are significantly less productive than older firms, which is in line with the literature on the impact of vintage on productivity (e.g., Jensen, McGuckin, and Stiroh 2001). Moreover, we find that firms with excess labor are less productive than firms without such a surplus. The two standardized factors denoting management style are significantly related to productivity as well. This is in line with the findings from Bartel (2004) who found that human resource management policies in service-sector firms affect firm productivity.

The results given in Column (3) include a set of variables that indicate the demand and competition the pharmacy faces.²⁷ Again, the finding that firms with a large share of part-time employment are more productive than firms with a large share of full-time employment is unaffected by the inclusion of these market characteristics. The 0.48 log point difference shows that a 10% increase in the part-time share is associated with 4.8% higher productivity. Because of the inclusion of control variables this establishment-wide effect of part-time employment has decreased slightly.

²⁷These controls are not significant either. We tried several alternative specifications for the measures for demand and competition, such as the number of inhabitants within a postal code area, the number of competitors within a radius of 10 kilometers, and the degree of urbanization. However, this did not change the estimation results.

Robustness Checks

We check the robustness of our findings to alternative model specifications.²⁸ First, we check the robustness of our results by using different thresholds for part-time employment, and by distinguishing core workers within firms in low, medium, and long part-time jobs and full-time jobs. When part-time employment is defined as a workweek of less than 21 hours, the coefficient of the part-time employment share is significantly higher than that of the full-time employment share. This also holds when part-time employment is defined as a workweek shorter than 22, 23, or 24 hours. For other definitions of part-time employment $h = [16, \dots, 20]$ or $h = [25, \dots, 33]$, we find no significant difference between the coefficient on firms' share of part-time and full-time employment.²⁹ In addition, we define the four groups of core workers within firms as follows: Employees in low part-time jobs work fewer than 16 hours per week, employees in medium-sized part-time jobs work between 16 and 24 hours per week, employees in long part-time jobs work 24 hours or more per week but fewer than 32 hours, and employees working 32 hours per week or more (i.e., 0.9 to 1.0 FTE) are defined as full-time workers. We compute the employment shares for these four groups of core workers and use, as previously, other employees as the reference group. Except for including two extra shares of employees, the estimation strategy remains the same. We find that the coefficient on the share of firms' medium-sized part-time employment (16–24 hours per week) is the largest, and significantly larger than the coefficient on the share of firms' full-time employment and of the share of firm's long part-time employment.

Second, we perform reduced-form analyses in which the dependent variable is equal to the number of prescription lines delivered to customers divided by the total number of FTEs in the firm. Instead of including employment shares, we first include firms' share of part-time core workers over total core workers measured in FTEs ($FTE_{PT}/(FTE_{PT} + FTE_{FT})$). This fraction is positively related to firm productivity. We also perform an analysis in which the firm's part-time employment share is measured in L : the number of part-time core workers divided by the total number of core workers ($L_{PT}/(L_{PT} + L_{FT})$). Again, the fraction of part-time core workers is positively related to firm productivity, after controlling for the usual confounders.

Third, by performing panel analyses on a subsample of our original sample, we try to deal with firm unobserved heterogeneity. For 95 firms, we have data not only from 2007 but also information on productivity levels and/or employment shares from two years earlier. Therefore, we estimate a

²⁸Regression results with respect to the robustness analyses can be found in Web Appendix C at <https://sites.google.com/site/annemariekuennnelen/web-appendix-ilrr>.

²⁹Because of the large variability of part-time hours within pharmacies (the average difference in minimum and maximum part-time hours within firms is 6.2 hours), the part-time shares within firms are what has changed in this robustness check. We do not see that firms shift from a mainly part-time to a mainly full-time classification by changing the definition of part-time employment.

fixed-effects model, a random effects model, a pooled OLS model, and we estimate a model solely on 2005 data. Finally, we instrument firms' employment shares in 2007, by their shares in 2005. Although we are aware of potential problems with some of these models, estimating them should give us an idea on the consistency of our main findings. All these models show a larger coefficient on firms' part-time employment share than on firms' full-time employment share. The differences are estimated in the range of 0.29 to 0.60, meaning that a firm with a 10% larger part-time employment share has a 2.9 to 6.0% larger productivity. Except for the fixed-effects model, the estimated differences in these models are statistically significant. The estimated difference in the main model without worker, firm, and market characteristics fits in this range. We are still careful in interpreting our results in a causal way, but these additional analyses suggest that our findings are likely to hold in a larger panel of firms as well.

Our robustness analyses show that firms with a large part-time employment share are more productive than firms with a large full-time employment share. This appears to be attributable to the fraction of part-time employees working between 16 and 24 hours per week, suggesting that these part-time workers are allocated most efficiently.

Why Is Part-time Employment Beneficial for Firm Productivity?

Our finding that firms with a large share of part-time employment are more productive than firms with a large share of full-time employment could be due to allocation efficiencies offered by part-time employment. If this is true, part-time workers do not have to be more productive than full-time workers in the hours they work for the use of part-time work to increase productivity at the firm level.³⁰ Especially in service-sector firms, part-time employment can, for example, be used to bridge the gap between hours the business is open and contractual working hours. Such a gap is also observed in our data. On average, firms are open around 50 hours a week whereas the full-time working week counts 36 hours (see Table 1). This illustrates the potential for allocation efficiencies related to (medium-sized) part-time employment over the workweek. A second way in which part-time employees can provide allocation efficiencies is by bridging the lunch breaks of their full-time colleagues so that firms can be open during the whole day without having to close during lunchtimes. A third argument for the beneficial allocation effects of part-time employment is the ability to accommodate fluctuations in customer demand. Part-time employment enables firms to cushion peak hours by deploying more workers during that time than during hours when the pharmacy is open but has lower customer demand.

³⁰We do not find evidence suggesting that part-time workers are more productive than full-time workers at the individual level. We find that training participation rates and gross wages among part-time and full-time core workers are similar, but part-timers actually report significantly lower self-rated competence and performance levels than full-timers. See Appendix B.

To gain more insight into the allocation efficiency of part-time employment, we use additional data on the timing of labor demand within the Dutch pharmacy sector. These data are provided by the administrator of a scheduling program that is used by almost half of all Dutch pharmacies.³¹ Therefore, we know the work schedules of all the employees of 900 pharmacies in January 2010. From this data set, we construct for each week the firms' number of core employees working and the fraction of part-time core workers in each half-hour time slot. Based on this information, we examine possible weekly and daily allocation efficiencies. The data show that part-timers work on average fewer hours per day as well as fewer days per week than full-timers. This already shows that part-time workers are allocated differently from full-time employees, which might benefit the allocation of labor in the firm both within days and within weeks.

Figure 1 shows the allocation of total labor and part-time employment over the days of the week. Total labor is measured by the number of half-hour time slots worked by all employees per day. We sum the number of half-hour time slots of all employees working in the firm on that day. The share of part-time employment is computed by the number of all time slots worked by part-time employees divided by the total number of time slots worked by all employees.

As shown in Figure 1, we find only small fluctuations in the total amount of labor deployed across days.³² This suggests that customer demand is quite stable across days. We find more fluctuations in the share of part-time employment. Especially on Wednesdays and Fridays, the share of part-time employment is smaller than on other days; however, this seems to be supply driven, since children below age 12 do not have classes on Wednesday afternoon and, additionally, children below age 7 do not have classes on Friday afternoon. Altogether, allocation efficiencies due to part-time employment over the workweek seem to come from the discrepancy between the full-time workweek and the number of open hours, and not from fluctuations in customer demand within workweeks.

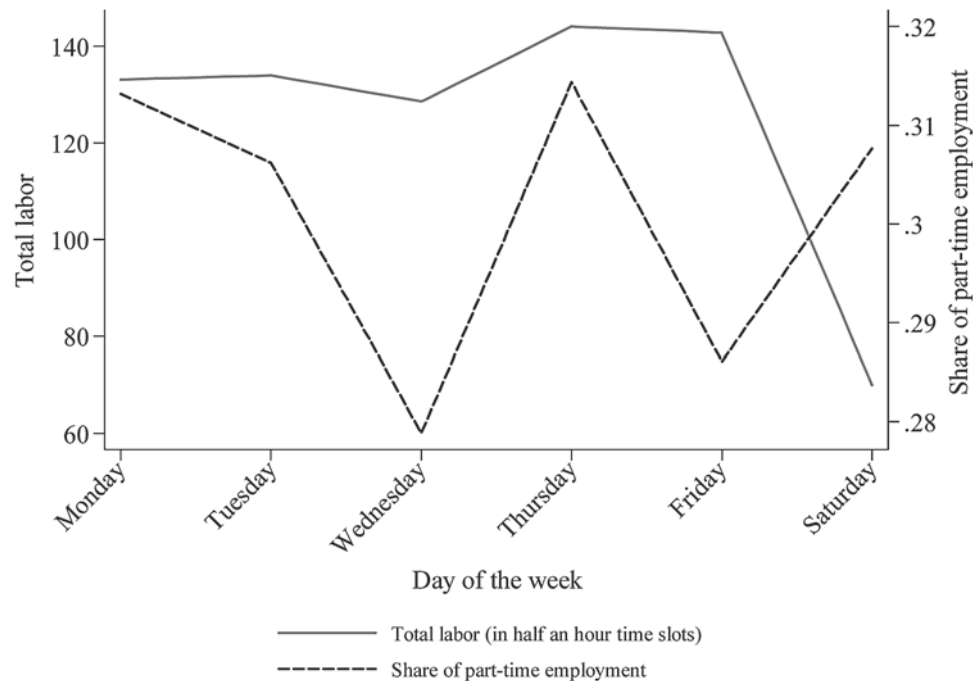
Figure 2 shows the allocation of workers over a typical working day—Tuesday.³³ The figure shows the average number of core employees and the fraction of part-time core employees. To see whether part-time employees

³¹This scheduling program is freely available online to Dutch pharmacies. It allows them to plan the work time of their employees and contains details on the positions of employees, their contractual working hours, and the time slots they are scheduled to work. Unfortunately, this data cannot be matched to the data we use for our productivity analysis.

³²Only on Saturdays is there a clear drop in total labor deployed due to a large number of firms that are closed that day: in 2010, only 38% of Dutch pharmacies are open on Saturdays, for a little more than 5 hours, mostly in the morning (ECORYS 2010). In the Netherlands, some pharmacies are open only during evening hours and over the weekends; these "night pharmacies" are not included in the sample. Moreover, regular pharmacies within a town or district often share schedules for rotating shifts on Saturdays, as weekend shifts are unprofitable (SFK 2008).

³³In Figure W3 in Web Appendix D (<https://sites.google.com/site/annemariekuennnelen/web-appendix-ilrr>), we include all days of the week (Monday through Saturday). The figures from Monday to Friday look very similar.

Figure 1. Allocation of Part-Timers over the Week



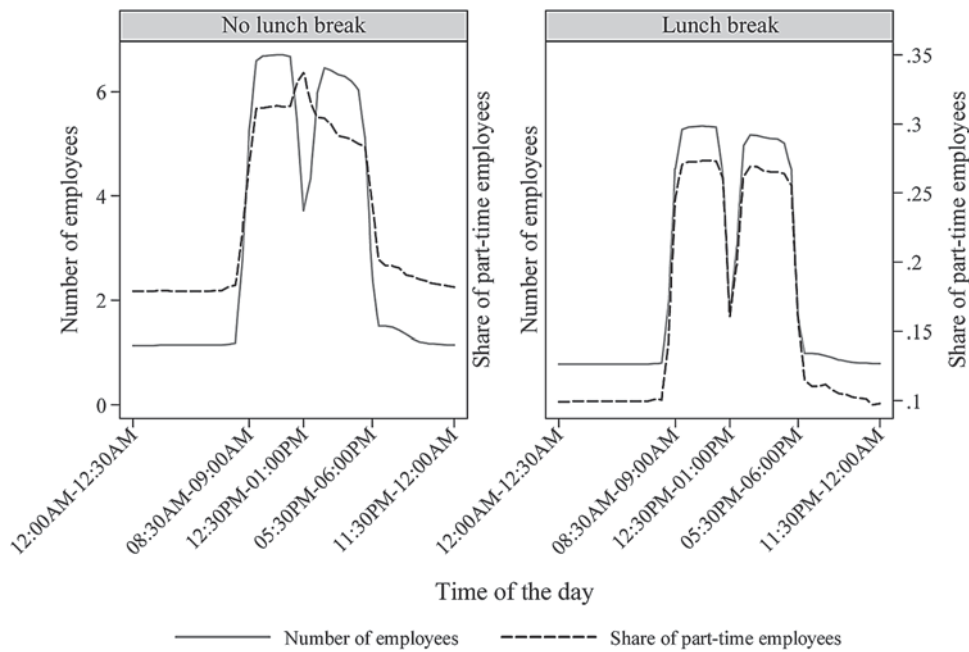
Notes: Total labor is measured in half-hour time slots. The share of part-time employment is defined as the number of part-time core employees over the number of core employees. We averaged all weeks within January 2010. Only 38% of the pharmacies in the sample are open on Saturday.

are used to bridge the lunch breaks of full-time workers, we distinguish between firms that deploy no core employees during lunchtime and firms that do deploy core employees during lunchtime.³⁴

To the extent that total labor inputs reflect customer demand, we do not observe much fluctuation during the day in this sector. The only exception is a daily low point during lunchtime (between 12:00 p.m. and 1:30 p.m.), which is more likely to reflect the necessity of a lunch break for full-timers than a low point in customer demand. Figure 2 shows that for all time slots, the fraction of part-time employees is larger in firms at which core employees are deployed at some time between 12:00 p.m. and 1:30 p.m. This implies that firms that do not have to bridge lunch breaks of their full-time colleagues deploy on average less part-timers. Firms deploying at least one core employee during lunchtimes, deploy more part-time workers in general, and they schedule part-time workers in such a way that they are working during lunchtime. This can be seen in the figure because for these firms (the “no lunch break” firms), the fraction of part-time employees is largest

³⁴The distinction between these two groups of firms is likely to reflect that some firms close for some time during lunchtimes while other firms remain open during lunchtimes. However, as we do not have information on hours of operation in this data set, we cannot be entirely sure about this.

Figure 2. Timing of Labor Demand on a Typical Workday



Notes: This figure is based on Tuesday (averaged over all Tuesdays in January). The “No lunch break” sample consists of firms that employ at least one core employee between 12:00 p.m. and 1:30 p.m. In the “Lunch break” sample this is not the case.

during lunchtime. This observation suggests that part-time workers are scheduled in a way that creates allocation efficiencies.³⁵

We conclude that the allocation of part-time workers is quite different from the allocation of full-time workers. Part-timers work fewer hours per working day, as well as fewer days per week than do full-timers. In particular, they seem to bridge the lunch breaks of their full-time colleagues. Moreover, part-time employment can be used to fill the gap between the number of open hours and the full-time workweek existing in this sector, as well as in other service-sector firms. Deploying a large fraction of part-time employees therefore seems to increase allocation efficiency over both the workday and the workweek, which contributes to greater firm productivity.

Conclusion

With this article, we are the first to analyze and explain the relationship between part-time employment and firm productivity. Our unique data set allows analyses of heterogeneous labor shares based on employees’ working

³⁵The data on the timing of labor demand do not include information on whether firms deploy core employees during lunchtime. Therefore, we cannot estimate the productivity model separately for these two groups of firms.

hours on a hard measure of firm productivity. Using a production function with quality-adjusted labor, we divide the workforce of each given firm into part-time and full-time core workers and other employees. Our focus on a particular occupation that employs almost exclusively women justifies our part-time definition of working fewer than 24 hours a week. We find that firms with a 10% larger part-time employment share are 4.8% more productive.

Furthermore, we show that allocation efficiencies provide an explanation for this difference in firm productivity. Additional data on the timing of labor demand show that part-time employees are allocated differently from full-time employees. We find that the fraction of part-time workers is especially large during lunchtimes, suggesting that part-time workers enable their full-time working colleagues to take lunch breaks. Moreover, part-time employment is used to bridge the gap between the full-time workweek and the number of hours a firm is open. This suggests clear allocation efficiencies due to part-time work.

The service sector employs a large share of the labor force in both the United States and Europe. The sector seems to provide good conditions for exploiting the allocation efficiencies offered by part-time labor. In the retail sector, these conditions are hours of operation that exceed the full-time working week as well as open hours during lunchtime. In other service sectors, such as restaurants and call centers, fluctuations in customer demand during the working day or working week could constitute such a condition. In both cases, allocation efficiencies of part-time employment can increase firm productivity. The finding that part-time employment is positively related to firm productivity in the service sector is not only relevant for employers in service sectors but also pertinent to policy debates on labor regulations and fiscal policies that either discourage part-time employment or encourage part-time jobs with social security rights equivalent to those for full-time jobs (e.g., Buddelmeyer, Mourre, and Ward 2008).

Appendix A

Relation between Firms' Employment Shares and Control Variables

In Table A.1 we estimate firms' part-time and full-time employment shares on the control variables used in our main analysis (Table 2) to check for potential correlations. The vast majority of firm characteristics are unrelated to firms' share of part-time employment. However, firms' part-time employment share turns out to be positively related to the average tenure of the core workers and of the pharmacist. The fraction of full-time employment is positively related to a dummy variable indicating whether a firm is newly founded and negatively related to the tenure of the pharmacist.

Table A.1. Relation between Firms' Employment Shares and Control Variables

<i>Dependent variable</i>	<i>Firm's part-time employment share</i> (1)		<i>Firm's full-time employment share</i> (2)	
Average age (pharmacy assistants)	0.003	(0.002)	−0.004*	(0.002)
Average firm tenure in years (pharmacy assistants)	0.009***	(0.003)	−0.002	(0.004)
Tenure pharmacist	0.002**	(0.001)	−0.003***	(0.001)
Independent pharmacy (yes/no)	−0.014	(0.015)	0.010	(0.020)
Number of operation hours per week	0.0002	(0.001)	0.0004	(0.001)
Excess labor (yes/no)	−0.004	(0.022)	−0.010	(0.028)
Sickness leave (%)	−0.275	(0.197)	0.211	(0.257)
Human resource schemes (standardized factor)	0.005	(0.008)	−0.001	(0.011)
Human resource development practices (standardized factor)	0.002	(0.008)	0.002	(0.011)
Newly founded firm	−0.076*	(0.042)	0.146***	(0.056)
East	0.018	(0.025)	0.003	(0.032)
Northwest	−0.005	(0.028)	−0.001	(0.036)
Midwest	0.011	(0.024)	−0.033	(0.032)
Southwest	−0.020	(0.024)	0.053*	(0.031)
Southeast	0.040	(0.029)	−0.046	(0.038)
Firm size (6–10 FTE)	−0.033	(0.032)	−0.015	(0.042)
Firm size (11–15 FTE)	−0.044	(0.033)	−0.041	(0.044)
Firm size (16–25 FTE)	−0.068*	(0.038)	−0.040	(0.049)
Constant	0.025	(0.074)	0.698***	(0.097)
Adjusted R-squared	0.1312		0.0978	
N	235		235	

Appendix B

Worker Quality

We interpret our finding that firms with a 10% larger part-time employment share are 4.8% more productive, as an establishment-wide productivity shift due to the use of part-time work within firms. Nevertheless, it could be that part-time employment is reserved for the highest quality pharmacy assistants so that our results could be explained by a difference in worker quality between part-timers and full-timers.

By means of both the administrative data from the pension fund and the employee survey, we analyze whether a quality difference is apparent between part-time and full-time employees. Our measures for worker quality are 1) a standardized factor of 19 self-rated key competences (such as, communication skills, knowledge of medications, and problem-solving skills), 2) self-rated overall performance level (on a scale from 1 to 10), 3) gross wage (in full-time equivalents), and 4) whether the worker participated in training last year. All of these quality measures have their strengths and weaknesses, but together they should provide insight about whether part-time employment is reserved for the highest quality assistants. In Table B.1, we report four worker-quality regressions. In these analyses, we control for workers' age and tenure, and we include firm fixed effects.

We do not find any evidence suggesting that part-time workers are more productive than full-time workers at the individual level. Even though we find that training participation rates and gross wages among part-time and full-time core workers are similar, part-timers actually report significantly lower self-rated competences and overall performance levels than do full-timers. The finding that part-timers and full-timers earn similar wages holds in most other Dutch occupations (e.g., Euwals and Hogerbrugge 2006).

Table B.1. Estimations on the Quality of Part-Time and Full-Time Workers

Variable	Competences (1)	Overall performance (2)	Log wage (3)	Training participation (4)
Part-time worker	-0.077*** (0.029)	-0.161*** (0.036)	0.003 (0.004)	-0.018 (0.017)
Tenure	0.001** (0.001)	0.004*** (0.001)	0.001*** (0.000)	0.000 (0.000)
Tenure squared	-0.000 (0.000)	-0.000*** (0.000)	-0.000*** (0.000)	-0.000 (0.000)
Age	0.042*** (0.011)	0.016 (0.013)	0.029*** (0.002)	0.006 (0.006)
Age squared	-0.001*** (0.000)	-0.000* (0.000)	-0.000*** (0.000)	-0.000 (0.000)
Constant	-0.471** (0.195)	7.409*** (0.245)	7.013*** (0.028)	0.694*** (0.113)
Model	Firm FE	Firm FE	Firm FE	Firm FE
Within R-squared	0.0274	0.0454	0.5535	0.0055
N	2,552	2,537	2,594	2,590

Notes: Standard errors are in parentheses. The table is based on firm fixed effects. The dependent variable *competences* is a standardized factor based on questions for which workers had to rate their competency in various skills on a scale from 0 to 10. The dependent variable *performance* is constructed from the question, "On a scale from 1 to 10, how do you rate your performance?" Wages are provided by the pension fund based on a full-time workweek. Training participation denotes whether someone participated in at least one training last year. Whereas the first two measures are subjective measures, the last two measures are largely institutionally determined since in the Netherlands part-time workers are protected by the law of equal treatment.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

References

- Aaronson, Daniel, and Eric French. 2004. The effect of part-time work on wages: Evidence from the social security rules. *Journal of Labor Economics* 22(2): 329–52.
- Arvanitis, Spyros. 2005. Modes of labor flexibility at firm level: Are there any implications for performance and innovation? Evidence for the Swiss economy. *Industrial and Corporate Change* 14(6): 993–1016.
- Baffoe-Bonnie, John. 2004. Interindustry part-time and full-time wage differentials: Regional and national analysis. *Applied Economics* 36(2): 107–18.
- Bartel, Ann P. 2004. Human resource management and organizational performance: Evidence from retail banking. *Industrial and Labor Relations Review* 57(2): 181–203.
- Brown, Charles, and James Medoff. 1978. Trade unions in the production process. *Journal of Political Economy* 86(3): 355–78.
- Buddelmeyer, Hielke, Gilles Mourre, and Melanie Ward. 2008. Why Europeans work part-time? A cross-country panel analysis. *Research in Labor Economics* 28: 81–139.
- Connolly, Sara, and Mary Gregory. 2008. Moving down: Women's part-time work and occupational change in Britain, 1991–2001. *Economic Journal* 118(526): F52–F76.
- Craine, Roger. 1973. On the service flow from labour. *Review of Economic Studies* 40(1): 39–46.
- Dearden, Lorraine, Howard Reed, and John Van Reenen. 2006. The impact of training on productivity and wages: Evidence from British panel data. *Oxford Bulletin of Economics and Statistics* 68(4): 397–421.
- De Grip, Andries, and Inge Sieben. 2005. The effects of human resource management on small firms' productivity and employees' wages. *Applied Economics* 37(9): 1047–54.
- Delsen, Lei. 2006. *Operating Hours and Working Time: A Survey of Capacity Utilisation and Employment in the European Union*. New York: Springer Press.
- Dostie, Benoit. 2011. Wages, productivity and ageing. *De Economist* 159: 139–58.
- Dutch Labor Supply Panel. 2006. Accessed at http://www.scp.nl/Onderzoek/Bronnen/Be knopte_onderzoeksbeschrijvingen/Arbeidsaanbodpanel_AAP (August 2013).
- ECORYS. 2010. *Arbeidsmarktmonitor Apotheekbranche, 2009–2010*. Nieuwegein: SBA.
- Ermisch, John F., and Robert E. Wright. 1993. Wage offers and full-time and part-time employment by British women. *Journal of Human Resources* 28(1): 111–33.

- Eurostat. 2010. Accessed at <http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/> (June 2010).
- Euwals, Rob, and Maurice Hogerbrugge. 2006. Explaining the growth of part-time employment: Factors of supply and demand. *LABOUR* 20(3): 533–57.
- Feldstein, Martin S. 1967. Specification of the labour input in the aggregate production function. *Review of Economic Studies* 34(4): 375–86.
- Hellerstein, Judith K., David Neumark, and Kenneth R. Troske. 1999. Wages, productivity, and worker characteristics: Evidence from plant-level production functions and wage equations. *Journal of Labor Economics* 17(3): 409–46.
- Hirsch, Barry T. 2005. Why do part-time workers earn less? The role of worker and job skills. *Industrial and Labor Relations Review* 58(4): 525–51.
- Ichniowski, Casey, and Kathryn Shaw. 2003. Beyond incentive pay: Insiders' estimates of the value of complementary human resource management practices. *Journal of Economic Perspectives* 17: 155–80.
- Ichniowski, Casey, Thomas A. Kochan, David Levine, Craig Olson, and George Strauss. 1996. What works at work: Overview and assessment. *Industrial Relations* 35(3): 299–333.
- Ilmakunnas, Pekka, and Mika Maliranta. 2005. Technology, labour characteristics and wage-productivity gaps. *Oxford Bulletin of Economics and Statistics* 67(5): 623–45.
- Iranzo, Susana, Fabiano Schivardi, and Elisa Tosetti. 2008. Skill dispersion and firm productivity: An analysis with employer-employee matched data. *Journal of Labor Economics* 26(2): 247–85.
- Jensen, J. Bradford, Robert H. McGuckin, and Kevin J. Stiroh. 2001. The impact of vintage and survival on productivity: Evidence from cohorts of U.S. manufacturing plants. *Review of Economics and Statistics* 83(2): 323–32.
- Leslie, Derek, and John Wise. 1980. The productivity of hours in UK manufacturing and production industries. *Economic Journal* 90(357): 74–84.
- Mabert, Vincent A., and Michael J. Showalter. 1990. Measuring the impact of part-time workers in service organisations. *Journal of Operations Management* 9(2): 209–29.
- Manning, Alan, and Barbara Petrongolo. 2008. The part-time pay penalty for women in Britain. *Economic Journal* 118(526): F28–F51.
- Montgomery, Mark. 1988. On the determinants of employer demand for part-time workers. *Review of Economics and Statistics* 70(1): 112–17.
- OECD Stat Extracts. 2010. Accessed at <http://stats.oecd.org/> (June 2010).
- Oi, Walter Y. 1962. Labor as a quasi-fixed factor. *Journal of Political Economy* 70(6): 538–55.
- Osterman, Paul. 1994. How common is workplace transformation and who adopts it? *Industrial and Labor Relations Review* 47(2): 173–88.
- . 2000. Work reorganization in an era of restructuring: Trends in diffusion and effects on employee welfare. *Industrial and Labor Relations Review* 53(2): 179–96.
- Owen, John D. 1978. *Working Hours: An Economic Analysis*. Toronto: Lexington.
- Pérotin, Virginie, and Andrew Robinson. 2000. Employee participation and equal opportunities practices: Productivity effect and potential complementarities. *British Journal of Industrial Relations* 38(4): 557–83.
- Roux, Sébastien. 2007. Les gains de la flexibilité d'emploi pour les entreprises: Le travail à temps partiel et de courte durée. *Reflète et perspectives de la vie économique* 46(2–3): 117–40.
- SFK (Dutch Foundation for Pharmaceutical Statistics). 2008. *Data en Feiten 2008*. Accessed at <http://www.sfk.nl/pdf-documenten/data-en-feiten/data-en-feiten-2008> (June 2010).
- Van Ours, Jan C., and Lenny Stoeldraijer. 2011. Age, wage and productivity in Dutch manufacturing. *Economist* 159: 113–37.
- Woods, Rose A. 2009. Industry output and employment projections to 2018. *Monthly Labor Review* 132(11): 52–81.
- Zwick, Thomas. 2006. The impact of training intensity on establishment productivity. *Industrial Relations* 45(1): 26–46.